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HURRICANE DAMAGED FORESTS

Still An Important State Asset



by

Austin F. Hawes, State Forester

Hartford

1939

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HURRICANE DAMAGED FORESTS STILL AN IMPORTANT STATE ASSET

by Austin F. Hawes, State Forester

Foreword

At the first meeting of the Forest Rehabilitation Committee appointed by Governor Cross after the hurricane, the Committee recommended the preparation of a bulletin:

a. to summarize the results of the hurricane from a forest standpoint.

b. to record the measures which were taken to relieve the situation.

c. to present a revised picture of the forests of the state as they are today and outline a forest policy for the future.

It was the thought of the Committee that a good deal of pessimism exists as to the forests because of the hurricane and that the public should be advised that in spite of the serious loss sustained the forests are still a source of great potential wealth to the state and deserve careful treatment if they are to fulfill their proper function.

It is for the purpose of carrying out this recommendation of the Committee that this bulletin has been prepared. Acknowledgment is made of many helpful suggestions received from various employees of the State Forestry Department and of the Connecticut CCC camps and special mention is made of contributions by Dr. Raymond Kienholz and W. F. Schreeder.

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1. THE HURRICANE

The hurricane which hit New England with such destructive effect on the afternoon of September 21, 1938 was of tropical origin. On the evening of September 16 it was located about 500 miles northeast of the Leeward Islands. Moving westward and then northwestward at the rate of 15-20 miles per hour it swung northerly up the coast past Cape Hatteras on the morning of September 21. (Figure 1.) It had gradually increased its speed of progress to 60 miles per hour when it hit the southern coast of Long Island and crossed to the Connecticut shore line. The center of the storm passed just to the west of New Haven at 3:50 P. M. and just to the west of Hartford at 4:17 P. M. Swinging slightly westward it crossed Massachusetts and Vermont (Northfield 7:30 P. M.) into Canada, where it was no longer destructive.

The cause of the increase in speed of its northward movement from 15 miles to 60 miles as it approached the Connecticut shore is not clearly known. The very rapid northward movement of the storm center together with its rotational movement, produced unusually heavy winds to the east of its path and relatively lighter winds to the west of its path. This accounts for the much greater destruction in eastern Connecticut and Rhode Island than in western Connecticut. Maximum wind velocities and directions as recorded by selected Weather Bureau Stations for 5-minute intervals were: Block Island, 82 miles per hour from the Southeast; Boston, (airport) 73S; Burlington, 47S; Hartford, 46NE and Providence 87SW. These figures do not, however, give one an adequate picture of the strength of the gusts of wind which were so destructive. At New Haven, where the maximum velocity for a 5-minute period as recorded by the Weather Bureau was about 45 miles an hour, the Koppers Coke Company recorded the strength of individual gusts as high as 87 miles an hour, nearly twice as strong as for a 5-minute period. If this relationship held throughout, wind velocities may well have reached over 100 miles per hour in most parts of the devastated area. The Blue Hills Observatory, Milton, Mass., located on a low hill, recorded 121 miles per hour for a 5-minute period and for shorter periods the wind reached a velocity of 173 and 183 miles per hour. The highest wind velocity ever recorded by means of an anemometer on Mt. Washington was 231 miles an hour on April 12, 1934.

The rainfall which preceded and accompanied the hurricane was excessive. Its distribution is shown in Figure 2. Central Connecticut received from 14 to 17 inches of rain from September 17 to September 22 inclusive. Probably 75 per cent of the rain fell prior to the time of maximum wind velocity and soaked up the soil until it was soggy and muddy. The soft condition of the soil undoubtedly had an effect on the firmness with which the trees were rooted and the consequent ease with which they were blown over by the wind. In con-

trast with the large amount of rainfall in central Connecticut the southeastern part of the state had only 4 to 5 inches of rainfall while Rhode Island stations reported even less (Providence 3.09, Kingston 2.80, Block Island 3.46).

Hurricanes similar in destructiveness to the one of September 21, 1938 occurred on August 15, 1635 and again on September 22, 1815. It is possible that widespread destruction of forests during these earlier storms may have resulted in the loss of much of the older timber

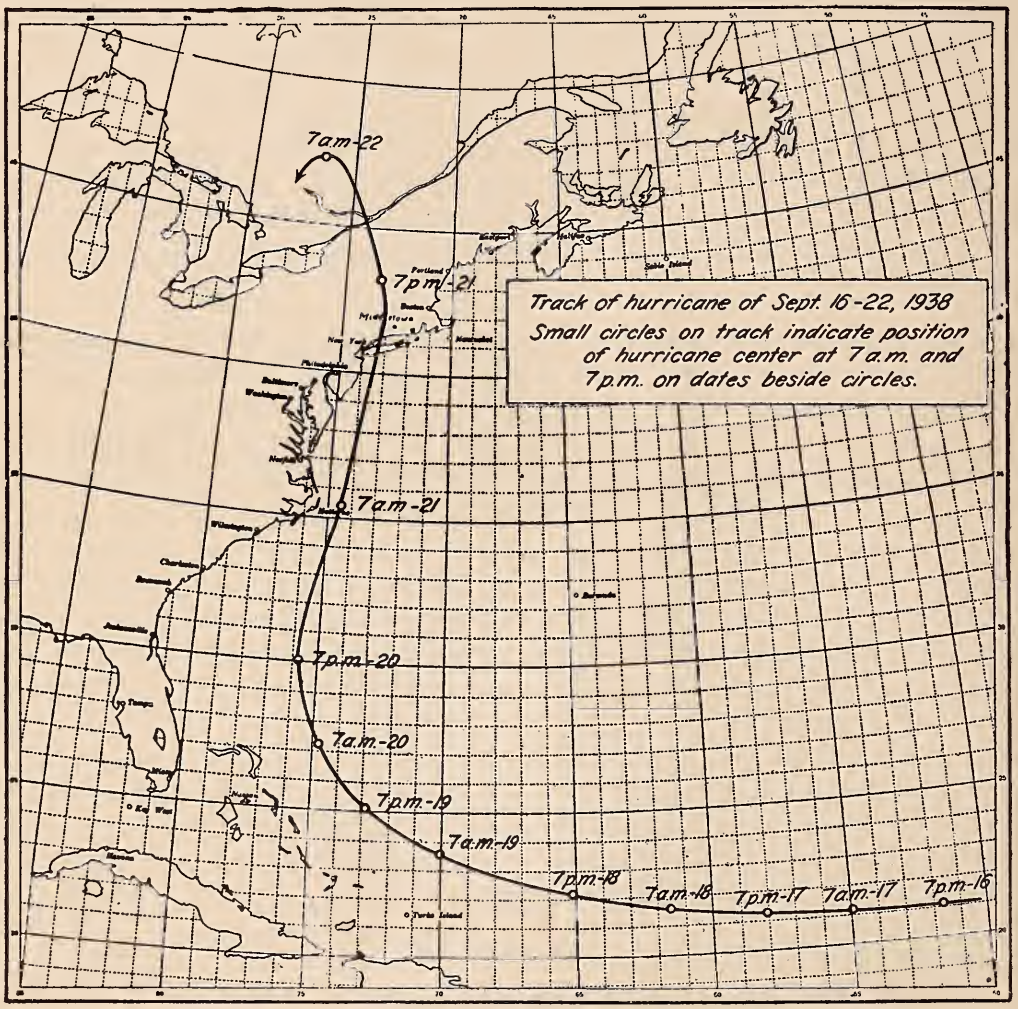


Fig. 1—Chart showing general path of hurricane and accelerated speed as it approached New England.
Courtesy of Professor Charles F. Brooks and Middletown Scientific Association.

as was the case in 1938 thus accounting in part for the absence of very large trees in the state during our generation, although extensive cutting has been the main cause of forest depletion.

The combination of soggy ground, strong wind and the sail surface of a full complement of leaves proved too much and many shade and forest trees were broken or blown over by the hurricane. If the hurricane had occurred after the hardwoods had lost their leaves the destruction would not have been nearly as severe as it was. The

sight of many trees in full leaf blown down across streets and roads, carrying down telephone wires, breaking down fences and buildings, and uprooting great masses of earth and roots carrying with them sections of sidewalk, was a depressing one. The leafy crown of a tree is a very large object when lying on the ground where one can see it easily. The result was a tendency for every one who saw the destruction immediately after the hurricane to over-estimate the number of trees which had been destroyed. A later, more thorough investigation of the damage reduced the first high estimates to more nearly the truth. However, estimates place the loss of public shade trees alone in Connecticut at over 100,000.

Most of the damage occurred east of the Connecticut river or, more accurately, east of the center of the storm; that is, east of a line drawn from New Haven through Hartford (Figure 1). The actual damage by counties will be discussed more fully later.

The greatest damage was done to pure stands of conifers of large size. This fact is repeatedly borne out by observations over the entire hurricane area. The Shaker Pines, north of Hazardville, were completely blown down. Very few trees were broken off, practically all were blown over. Wherever breakage occurred investigation nearly always showed the ravages of carpenter ants or decay fungi. The main stand of the Shaker Pines, 70 years old, averaged about 80 feet in height and was made up of white pine with a few red pine intermixed. Practically all older stands of white pine east of the Connecticut River were partially or completely destroyed.

The beautiful old stand of hemlocks along Mashamoquet Brook was completely blown down as was also much of the stand of hemlocks at Devils Hop Yard State Park.

The extensive stands of southern white cedar in the swamps near Voluntown (Pachaug Forest) were very heavily damaged by the hurricane. Shallow-rooted, tall, in dense stands, the wind literally pushed over whole acres of these trees as though a great hand had slowly but inexorably swept over the land, leveling everything before it. Sometimes the wind pushed the trees only part way over and they now lean at a sharp angle.

Old plantations of white pine (Mt. Higby Reservoir, Middletown Water Board, and Nipmuck Forest, Union) red pine (Rainbow plantations), Scotch pine (Rainbow plantations) and spruce were badly damaged, usually being almost completely blown over. In a few cases the mixed hardwood type was also heavily damaged. Where the hardwoods overtopped the pine and hemlock, they suffered more heavily than the pine and hemlock.

Large, dominant trees were more severely damaged than smaller, suppressed trees. In the stands of uneven age the dominant trees whose crowns extended into or above the dominant canopy were almost always broken or wind thrown wherever the damage was at all evident. This was usually true of mixed hardwoods or of stands of

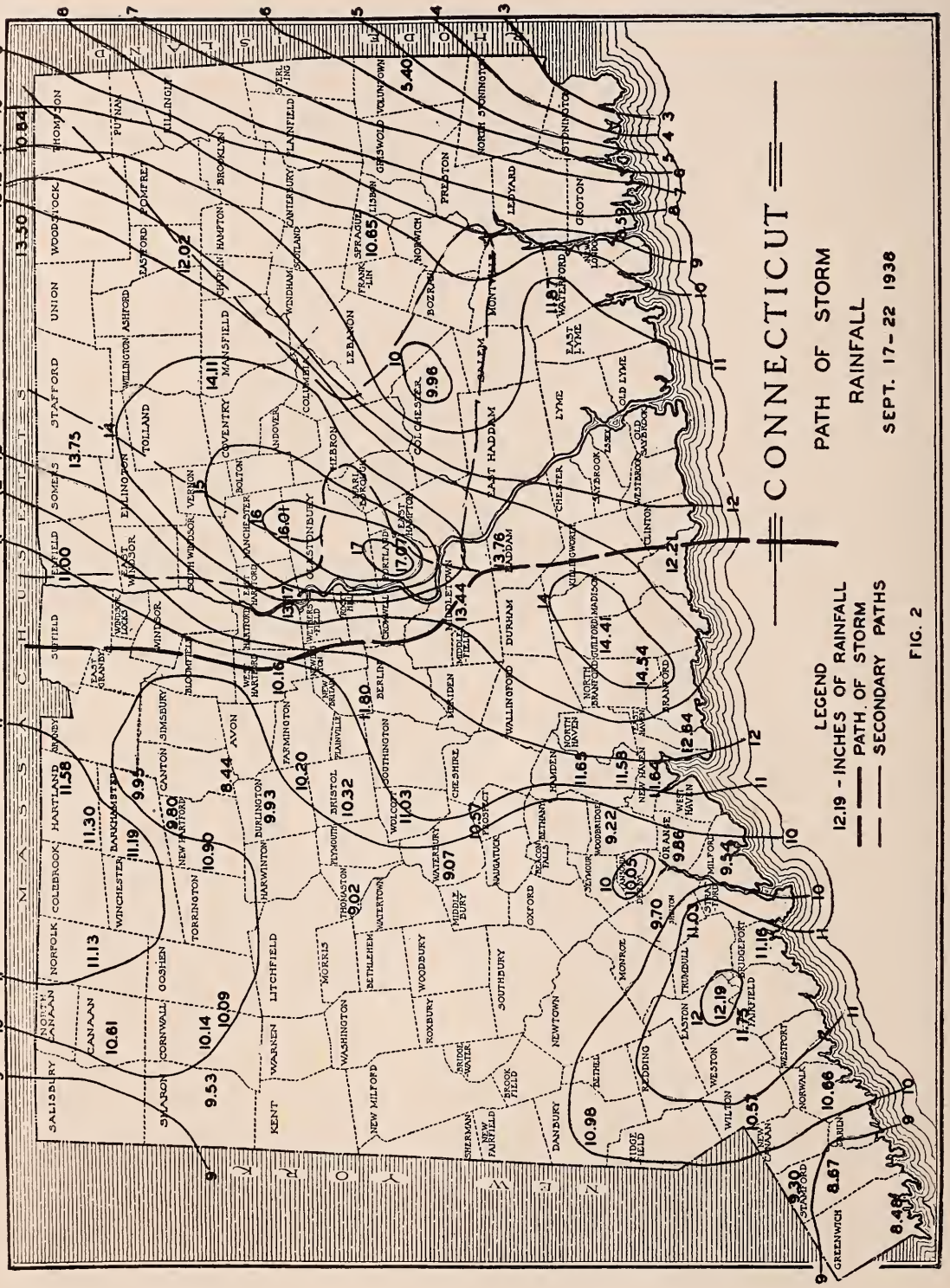


Fig. 2—Chart showing rainfall September 17 to 22, 1938.

hardwoods with an understory of conifers and especially true of isolated pine or hemlock scattered through a hardwood stand. Tulip, because of its rapid height growth, often extended above the rest of the stand and was frequently wind thrown.

On the Pachaug Forest in southeastern Connecticut on an area largely white oak, the damaged trees averaged 10.8 inches in diameter at breast height while the unharmed trees averaged 7.3 inches in diameter. On another area, largely scarlet oak, the damaged trees averaged 10.5 inches D. B. H. and the erect trees 8.8 inches D. B. H.

In a few cases, pine under hardwoods was damaged, while the hardwoods were not.

Some species, such as hickory, white oak, ash and sugar maple, seemed less subject to damage than others. There was great diversity of opinion among observers concerning the ability of the different species to resist hurricane injury, but wide observation indicates that hickory, hard maple, white oak and white ash were most resistant to injury in the order named.

Some species, such as large-toothed poplar, trembling aspen, cottonwood, scarlet oak and tulip, were particularly subject to hurricane injury. The poplars showed up badly, both in the forest and as shade trees. The prevalence of scarlet oak in the southeastern part of the state, coupled with heavy wind and lack of rainfall caused excessive breakage. Some observers reported spruce plantations less damaged than red pine. Others could see no difference in the number of trees damaged but found less breakage in spruce. The scarcity of older plantations of spruce makes a comparison between the two species difficult. Old Norway spruce planted as shade trees went down badly because of the extensive crown they carry, but the same was true also of white pine.

Isolated hemlocks were fairly resistant to wind throw, particularly when growing on upland soil. In swamps or on exposed rocky situations they were apt to be wind thrown.

In the Rainbow plantations, Scotch pine, although damaged to about the same extent as red or white pine, was very much more apt to be broken while red or white pine were more apt to be wind thrown. This was true also of mixed plantations of these species.

Scarlet oak was most severely damaged and white oak least severely damaged of the oaks.

Easterly slopes were most frequently damaged followed by southerly slopes. Northerly and westerly slopes were least damaged.

In the western part of the state northerly and westerly slopes were apt to be damaged more frequently than in the eastern part of the state because the strongest winds were from that direction on the west side of the storm.

Ravines were usually severely damaged no matter what direction they ran because of the funnelling of the wind through them (Illick

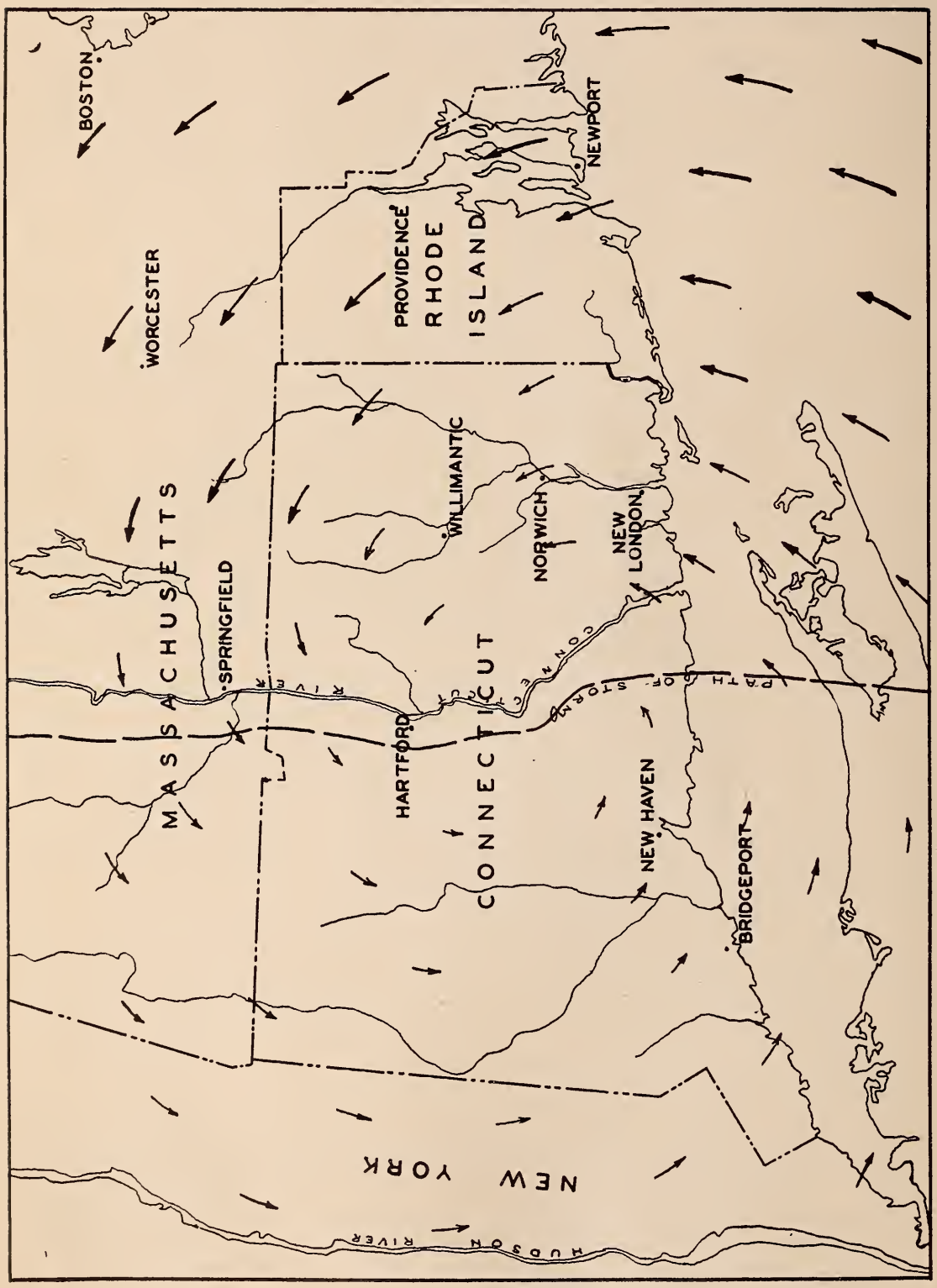


Fig. 3—Chart showing counterclockwise wind movement and relative intensity.



Hardwoods Damaged Through Breakage. Note Large Amount of Inflammable Material.

plot, Cockaponset Forest). The more rolling terrain of the southeastern part of the state did not protect the north and west slopes as did more rugged terrain in the northwestern part of the state.

The shallow rooting characteristic of hardwoods or softwoods in swampy soil caused heavy damage, particularly wind throw, along streams and in and around swamps (red maple).

In general, mixed hardwood stands under 40 years old were very slightly damaged. There were small areas in which stands younger than 40 years were damaged but the chief damage to the younger trees came from the falling of the overstory trees. Scarlet oak younger than 40 years tended to be severely damaged, whereas white oak of that age stood up well.

Softwood plantations under 15 years of age were seldom damaged. Damage varied greatly with location, some of the plantations near the Sound, as at South Lyme, were damaged even though young. It might be better to substitute for age the criterion of height. Plantations under 10 feet in height were lightly damaged: from 10 to 20 feet were moderately damaged and over 20 feet were heavily damaged. Fortunately most plantations in the state are small, hence were not damaged.

Salt water spray turned many trees partially or wholly brown. This browning was noticeable many miles inland. The effect of salt spray has already proved serious on many conifers within a few miles of the shore.

Breakage was more frequent on dry sites than on moist and more frequent in the southeastern part of the state where rainfall, just before the hurricane, was scanty. The heavy rainfall which preceded the hurricane, softened the soil so that roots did not hold well when subjected to wind strain and the trees were blown over rather than broken. A very sharp gust of wind might cause breakage even in trees rooted in a wet soil but the prevalence of wind throw rather than breakage in moist, low lying areas is indicative of the effect of moisture. A possible exception to this was found in very wet swamps, where the trees already accustomed to growing in wet soil were not affected by additional rainfall and sometimes withstood the hurricane.

Breakage east of the Thames River was estimated, on a number of quarter acre plots, as 40 per cent of all damaged trees while west of the Thames River it was estimated at 20 per cent.

White pine was more subject to breakage than pitch pine; scarlet oak than white oak; Scotch pine than red pine and white pine than Norway spruce.

Trees which originated as sprouts were more subject to wind throw and basal breakage than trees which originated from seed. This was particularly noticeable in sprout scarlet oak where there was considerable rot at the base of the tree. The rotting stump often infects the sprouts that grow from it. This is not true of trees of seedling origin.

2. THE WAY IN WHICH THE FOREST EMERGENCY WAS MET

Within a few days after the hurricane several New England conferences were held in Boston. These were attended by the state officials responsible for forest protection, forestry educators, timber owners, lumber manufacturers and others interested. At that time the amount of timber blown down in New England was estimated as in the vicinity of three billion board feet. It was evident that if this tremendous amount of lumber was thrown upon an unregulated market a price war would result so that neither manufacturers nor land owners would be able to salvage any value from the down timber. The Federal Government was, therefore, petitioned to handle this problem by some method similar to the way other surplus crops have been handled. President Roosevelt appointed Chief Forester Silcox as Federal Coordinator for New England for all problems having to do with forestry.

The New England Forest Emergency Project was established by the U. S. Forest Service early in October with headquarters in Boston under Mr. Earl Tinker and branch offices in each of the New England States. After some delay arrangements were made with the Reconstruction Finance Corporation to set up the Northeastern Timber Salvage Corporation for this purpose.

Immediately after the hurricane publicity was issued by the State Forester urging all timber owners, who had been damaged by the hurricane, not to sell their timber at sacrifice prices. Col. Thomas Hewes, who had been appointed State Coordinator by Governor Cross, called a meeting of land owners in the State Capitol on October 11th when the tentative plan of Government purchase was outlined.

In addition to the Rehabilitation Committee Governor Cross appointed three sub-committees to deal with Forest Fires, Timber Salvage and Forest Rehabilitation.

These committees held several meetings and made valuable recommendations which were printed in the Report of the Rehabilitation Committee. The most important of these recommendations were as follows:

1. A State appropriation of $100,000. for labor and equipment to meet the unusual fire hazard resulting from the hurricane.
2. A State appropriation of $5,000. for the installation and operation of a saw mill in the Pachaug State Forest.
3. A State appropriation of $13,000. for a study of the local forest products market and of local wood utilization possibilities.
4. A revolving fund of $10,000. to finance the logging of down timber on the state forests.
5. An appropriation of $10,000. a year for three years for the establishment of a state nursery to supply planting stock to farmers and other land owners.

6. An appropriation of $200,000. a year for the biennium for the acquisition of state forests in the devastated area.
7. The passage of a bill to encourage the establishment of town forests.
8. The passage of a bill for the regulation of clear-cutting of forests.

FIRE HAZARD REDUCTION

From the day of the hurricane the C. C. C. had rendered valuable service to the Highway Department and the various towns in opening roads, doing sanitation and other emergency work. After the completion of the emergency work all efforts of the C. C. C. were concentrated on fire hazard reduction. The U. S. Forest Service also sponsored a W. P. A. project to use 2000 men in Connecticut but except for a short period not more than one-quarter of this number were available. Governor Cross made $10,000. available for W. P. A. transportation. For purposes of fire protection the hurricane zone was divided into nine Fire Control Areas using rivers and state highways as boundaries. The sides of these roads were cleaned up by January 1, 1939 to a width of 50 feet in hardwoods and 100 feet in softwoods. This cleaning consisted in cutting and burning small branches and twigs of wind thrown trees. Tree trunks and usable limbs were left on the ground for the owners' use on the theory that these are not readily inflammable. This cleaning was for the dual purpose of preventing the starting of fires on the roadsides and to establish adequate fire lines where large fires can be checked. Upon the completion of the work on the roads bounding the main areas these areas were sub-divided by other roads into 61 fire blocks.

Early in January 1939 Governor Baldwin secured an emergency appropriation of $350,000. for repair of damage caused by the hurricane. Of this $31,730. was allotted to the Forestry Department for fire hazard reduction. Twelve crews of 15 men each were employed from the beginning of February to supplement the work of the C. C. C. and the W. P. A. with the result that the boundaries of the 61 subdivisions and many other roads were cleaned up in the way described above before April 1st. Debris had also been cleaned away from practically all houses for a distance of 200 feet.

Congress passed a Deficiency Bill appropriating $5,000,000. for fire hazard reduction work in New England. Connecticut's share of this appropriation is $500,000. With this money the Forest Service is employing about 400 men to do similar work on areas which had not been covered by the State, C. C. C. and W. P. A. crews.

TIMBER SALVAGE

The Timber Salvage Administration set up three grades of pine logs with prices of $18, $14, and $12 per thousand feet delivered at designated stations. However, the owner receives only 90 per cent of these prices, as 10 per cent is retained by the R. F. C. to assure

the financial success of its program. All pine logs are to be stored in ponds or sawed immediately upon delivery. Up to June 30, 1939 twenty-one ponds had been designated in Connecticut for storage of pine. The amount contracted for is 23,800,000 bd. ft. and the amount delivered is 10,400,000 bd. ft.

Prices offered for hardwood logs such as white wood, yellow birch, sugar maple, ash and beech, red and white oak are $22, $16, and $12 respectively for 1st, 2nd and 3rd grade logs. Oak logs must have a minimum length of 8 feet 6 inches. Obviously the land owner only receives $10.80 per thousand board feet for hemlock, hardwood tie logs, and third grade pine.

There have been 175 stations set up for the delivery of hardwood and hemlock logs. The amount contracted for is 31,260,000 bd. ft. and the amount delivered 4,700,000 bd. ft.

Up to the present time the logs sold to the Timber Salvage Administration have averaged $12.49 per thousand board feet.

Of all logs received by the Timber Salvage Administration in Connecticut the average price paid for pine has been $12.09 and for hardwoods $13.72. The Administration is operating eleven saw mills in Connecticut at present.

Due to the delay in getting the Government program under way many landowners had sold their logs to private operators or arranged to have their logs custom sawed. It is estimated that the total amount salvaged privately to date is about 11,000,000 bd. ft.

An allotment of $19,350. was made by Governor Baldwin to salvage logs from the state forests and purchase the necessary equipment for the manufacture of part of the lumber. A Chase No. 1 saw mill with edger and gasoline power unit was purchased for the Pachaug forest where there was the largest amount of timber available. The planer formerly at Natchaug forest was moved to Pachaug. Sawing of white pine and hemlock was begun on March 25, 1939 under an order from the Public Works Department to furnish kiln-dried dressed lumber for the reconstruction work at Hammonasset Beach. What is known as an Arkansas dry kiln was made near the mill. This consists in a series of ditches like those for a barbecue in which slab wood is burned. The lumber is piled about seven feet above ground level. The intervening space is enclosed with old tin and fires are covered with metal. This kiln proved so efficient that 2″ x 4″ lumber was sufficiently dried for use in a week. Up to June 30, 1939, 508,500 board feet of lumber had been sawed.

In addition to milling these logs at Pachaug contracts were made with the Northeastern Timber Salvage Administration to sell logs from the Pachaug, Quaddick, and Natchaug forests to the Government. Up to June 30, 1939 logs amounting to 290,845 board feet had been delivered at the Government stations from the state forests. The average price paid for these logs was $11.81 per M.

AGRICULTURAL CONSERVATION PROGRAM

Another measure which has been a great help to land owners in cleaning up the hurricane debris is Practice 12 adopted under the Agricultural Conservation Program which is administered by the Agricultural Extension Service at the College. Under this practice land owners are paid $4. an acre up to 15 acres on any holdings for cleaning up hurricane destroyed woodland. Up to the middle of March 756 applications had been received and 543 had been approved covering 6404 acres of forest. The largest areas are in New London, Tolland and Hartford Counties.

EMERGENCY FIRE PLAN

The allotment of $4920. by Governor Baldwin for fire fighting equipment made it possible to provide every deputy fire warden as well as the district fire warden with the standard equipment which consists in 3 shovels, 3 brooms, 3 fire tools, 4 to 6 pails and 2 knapsack pumps. For each trained registered crew of ten men that a warden has this list of equipment is duplicated. By the first of April 1939 there were 97 of these trained crews fully equipped in addition to 139 district and 529 deputy wardens.

Arrangements were made to have six crews of 20 men each in the seven C. C. C. camps fully equipped and trained and ready for fire calls. All other crews engaged in fire hazard reduction work whether employed by the State, W. P. A. or other Federal Government agencies were available for fire fighting.

Two additional trucks were equipped with transmission and portable power pumps each with a half mile of hose. This made thirteen state owned power pump units of which ten were in the hurricane zone. In addition the Government furnished seven power pumps for the C. C. C. camps in this area.

Only one lookout tower, that in Sterling, had been seriously damaged by the hurricane and this had been repaired immediately after the storm. There were, therefore, seventeen lookout towers in operation during the spring of 1939. Provision has been made for the erection of two additional towers before next fall.

Arrangements were made with the U. S. Weather Bureau to have weather conditions reported to the Boston office from seven forest stations in Connecticut. The Boston office of the Weather Bureau notifies the various broadcasting stations of the fire weather conditions and this information is broadcast at various times so that all wardens with radios can keep informed of conditions. Five danger classes of weather are recognized from No. 1 when there is no hazard, to No. 5, Extreme Hazard. Wardens have instructions not to issue permits for fires on Class 4 or 5 days.

SPRING FIRE SEASON OF 1939

Weather conditions were fortunately unusually favorable for the control of forest fires throughout the early part of the spring. There was a considerable snowfall on March 13th, with the result that very

few fires occurred in March. This favorable condition was somewhat counterbalanced by the prolonged drought in May and June, but fires burn more slowly after the new foliage is formed and consequently they were controlled effectively. Up to June 29 reports had been received of 893 fires which burned 3054 acres or an average of 3.5 acres per fire. This may be compared with 1444 fires at the same time in 1938 with an average of 4.8 acres per fire. The largest fire of the season, which burned 165 acres, was west of the area affected by the hurricane. The prompt action of fire crews resulted in controlling the fires within as small areas as before the hurricane.

3. ESTIMATE OF HURRICANE DAMAGE TO THE FORESTS

Immediately after the hurricane it was evident to every one that there had been a tremendous damage both to the shade trees and to the forests of the state. The best available information indicates that approximately 100,000 shade trees on public highways and in public parks were destroyed. No figures are available on the number of shade trees destroyed on private property, but it undoubtedly exceeds the above estimate.

While it has been impossible to make an accurate estimate of the timber damage, the forest rangers of this department have visited all sections of the hurricane zone and interviewed a great many land owners. Because of the fact that most of the forests in this area were young, the average stand per acre before the hurricane contained little merchantable timber. While a great many trees that were destroyed were large enough for logs, their scattered condition and distance from roads makes salvage in many cases impracticable. Consequently, there is a wide divergence between the estimated total damage and the amount considered salvagable as indicated in Table No. 1.

Figures given above indicate that about 66 million board feet have been contracted for up to June 30th which is about sixty per cent of the estimated salvagable material, while only 26 million feet had been delivered. This is about one-quarter of the estimated salvagable. It is a well known fact that most of the work thus far has been in salvaging white pine. If a real effort is made to salvage hardwoods, it is believed that the total will not be far from the 111 million feet estimated.

In addition to the timber estimated above it is safe to say that at least 1,500,000 cords of wood in small trees and tops of large trees are on the ground and that only a relatively small part of this wood can be salvaged because of the lack of wood using industries in the region.

On the basis of a survey of 113,000 acres in private forests surrounding the various state forests the standing timber of the state was estimated four years ago to be 1,771,100,000 board feet. Reduc-

TABLE NO. 1—ESTIMATED TIMBER DAMAGE CAUSED BY THE HURRICANE

COUNTY	Softwoods		Hardwoods		Total	
	Total Damage Bd. Ft.	Salvagable Bd. Ft.	Total Damage Bd. Ft.	Salvagable Bd. Ft.	Total Damage Bd. Ft.	Salvagable Bd. Ft.
	a	b	c	d	a & c	b & d
Tolland	12,900,000	8,200,000	46,000,000	11,000,000	58,900,000	19,200,000
Windham	54,000,000	30,800,000	60,000,000	9,000,000	114,000,000	39,800,000
New London	7,000,000	4,700,000	100,000,000	25,000,000	107,000,000	29,700,000
Middlesex	3,600,000	1,100,000	33,000,000	6,000,000	36,600,000	7,100,000
Hartford	3,200,000	2,700,000	10,000,000	1,000,000	13,200,000	3,700,000
Remainder of State	14,300,000	4,500,000	24,000,000	7,000,000	38,300,000	11,500,000
Total	95,000,000	52,000,000	273,000,000	59,000,000	368,000,000	111,000,000

ing all products to cords the total volume was estimated at 12,970,000 cords. During the succeeding four years this growing stock had increased about 1,000,000 cords so the total before the hurricane was approximately 14,000,000 cords.

The timber blown over was, therefore, about one-fifth of the total timber of the state but if the total damage were converted to cordwood it would amount to about one-sixth of the total volume.

For the purposes of the State Rehabilitation Commission the entire forest damage was placed at $1,660,000. which is about 6 per cent of the total property damage caused by the hurricane. This estimate, of course, ignores the indirect values of the forests destroyed such as for summer resort property, protection of water, and wild life and the prevention of erosion. These are intangible values which cannot be estimated even approximately.

4. PRESENT CONDITION OF THE FORESTS OF THE STATE

While the forests of Connecticut have been in a deplorable condition ever since the death of the chestnut in the early years of the present century, the timber loss through the hurricane was undoubtedly less than it would have been except for this fact. Surveys made in 1930 and '31 indicated that only 8 per cent of the forest area of the state was covered with trees of the tie and timber age class. Even allowing for a slight increase since that time, it is safe to say that this age class did not much exceed 10 per cent at the time of the hurricane. Most of the hardwood damage was in this age class, although many individual trees in younger age classes were destroyed. This, however, is not true of the softwoods, for whole stands of these of all ages were uprooted. While estimates indicate that about one-fifth of the timber of the state was destroyed, the damage to the softwood forests was proportionately greater. Whereas before the storm there were approximately 215,000 acres in the state covered with forests containing a considerable proportion of evergreens, it is safe to say that this area had been reduced to about 160,000 acres including perhaps 25,000 acres of plantations. After the salvage of the hurricane damaged timber, the proportion of softwood to the total lumber production of the state will undoubtedly be less for many years than it has been during the recent past.

The forests of Connecticut now contain approximately one and one-half billion board feet of timber of merchantable size. Owing to the fact that it is scattered over such a large area, much of it is not actually merchantable and will not be until the average stand per acre has increased. This timber is made up largely of the various species of oak and birch together with red maple, hemlock and white pine and small quantities of ash, hickory and tulip or white wood.

Serious as was the damage suffered by Connecticut forests from the hurricane, it was no more serious than less spectacular damage in



The Beautiful Shakers Pines Entirely Destroyed.

the past through unwise cutting practices and the uncontrolled fires which often followed in their wake. The great economic loss caused by the hurricane as from the chestnut blight was due to the fact that most of the smaller trees destroyed could not be salvaged. In the 27 years previous to 1931 the average annual lumber cut in the state was 79,855,000 board feet, although in the last ten years of the period it was only 45,600,000 feet a year. Neither of these amounts would have been excessive if they had been made through the proper selection of mature trees from a forest with a proper distribution of ages. It was the long continued practice of cutting all the trees on a tract regardless of size and age which had resulted in an excess of young forests and a scarcity of mature timber. This is known as clear cutting as contrasted with a selection cutting which removes only the large or defective trees and leaves vigorous young trees to grow. Since the depression the annual lumber cut in Connecticut has been only about 8,634,000 board feet. A more important factor in the recovery of the forest has been the reduced clear cutting of cordwood which was formerly in demand by the brick, lime and brass industries. The annual area burned by forest fires has also fallen from 34,540 before 1931 to 6,900 acres since '31. The result of these changes is that the forests are now in better growing condition in spite of the hurricane than they were a decade ago. This is indicated by the following table.

TABLE NO. 2—COMPARISON OF FOREST AGE CLASS DISTRIBUTION OF 1930 AND 1940.

	1930	1940
Estimated Forest Area.....	1,789,000 acres	1,825,000 acres
Approximate proportion of Forest 1 to 20 years old (Saplings).....	35 per cent	28 per cent
Approximate proportion of Forest 21 to 40 years old (Cordwood).....	32 " "	33 " "
Approximate proportion of Forest 41 to 60 years old (Polewood).....	25 " "	28 " "
Approximately proportion of Forest 61 and over (Timber).....	8 " "	11 " "
	100 " "	100 " "

If a forest is to produce an annual crop it must obviously have a fairly even distribution of trees of all ages so that each year there will be about an equal number of large trees to cut. It makes little difference to the State whether there is an equal number of acres covered with each age class. Thus a forest of 1000 acres might have a mixture of trees throughout varying from 1 to 100 years (a selection forest) or it might have 10 acres covered with each age class from 1 to 100 years (an even aged forest). In either case it would be considered a "normal forest" because it would be possible to cut the same amount of timber every year. Contrast such a "normal forest" with

the forests of Connecticut where only 11 per cent of the trees are over 60 years of age, and where 89 per cent of the forest has little of commercial value. Evidently the Connecticut forests cannot be very productive until this condition is rectified. Table No. 2 shows that some progress in this direction has been made in the past decade.

A decade ago the area of forest 41 to 60 years old was estimated at 447,000 acres. Approximately half of this area is now in the age class 61 years and over. Thus in spite of the fact that most of the damage done by the hurricane was to the older trees, the total area now in the older age class is larger than it was ten years ago.

The U. S. Government Timber Salvage Program should be of lasting value to the forests and forest owners of Connecticut. It not only stabilized the market and enabled land owners to secure a fair price for logs which would otherwise have been unmarketable, but it has given timber owners an elementary knowledge of volume, grades and values and it is teaching saw mill operators how to produce and pile good lumber. The soundness and high quality of Connecticut timber being produced under these new conditions is proving a revelation to many former skeptics.

Under the grading rules of the Northeastern Timber Salvage Administration three grades are recognized for white pine and hardwood logs. Certain variations are permitted in each grade but a premium is paid for size, soundness and straightness.

TABLE NO. 3—COMPARISON OF LOG PRICES BY GRADES[1] PAID BY NORTHEASTERN TIMBER SALVAGE ADMINISTRATION

Kind of Timber	First Grade	Second Grade	Third Grade
White Pine	$18.	$14.	$12.
Hardwoods	22.	16.	12.
Hemlock	—	—	12.

The advantage from raising high grade logs is obvious when the prices between first and third grade logs are compared. In the case of white pine first grade logs must be at least 13 inches in diameter at the top and free from defects while third grade logs need be only 6 inches in diameter. The size of logs is, of course, determined by the age of the forest, the quality of the soil and the kind of management the forest has had. The better the management the greater will be the number of high grade logs on an area, for each successive thinning removes the poorest trees and lowest grade logs.

Table No. 3 shows at a glance that a premium is paid for logs of large diameter and long lengths. First grade pine logs are worth 50 per cent more per thousand feet than third grade. In hardwoods emphasis is on soundness and straightness. First grade logs are worth 83 per cent more than third grade logs.

(1). These prices are for logs per thousand board feet delivered at a depot established by the Administration.

A surprising proportion of the hardwood lumber, about 45 per cent, has graded No. 1, with 15 per cent No. 2, and 40 per cent No. 3. Of the pine logs received previous to May 1 about 5 per cent were No. 1, 75 per cent No. 2, and 20 per cent No. 3.[1]

Obviously more labor is involved in handling a lot of small logs than the equivalent volume in large logs. The International Log Rule was adopted by the Northeastern Timber Salvage Administration because it has been found to give the most accurate results. The number of logs of a few random sizes required to make 1000 board feet of lumber is indicated by Table No. 4.

TABLE NO. 4—COMPARISON OF NUMBER OF LOGS OF VARIOUS SIZES REQUIRED TO MAKE 1000 BOARD FEET OF LUMBER

Diameter inside bark at top	Length of logs	Number of logs required to saw 1000 board feet
Inches	Feet	
6	10	100
7	12	50
8	12	40
9	16	20
13	14	10
17	16	5
23	14	3
26	16	2
39	14	1

Investigations made several years ago proved that it takes twice as long to fell and cut up 1000 board feet of logs from trees 8 inches in diameter as from trees 25 inches in diameter. It takes three times as long to skid logs 8 inches in diameter as logs 20 inches in diameter; four times as long to load them and twice as long to saw them.

When the factors of additional cost for handling small logs are combined with the differential in value between large and small or defective logs, it follows that the profit from marketing first grade logs of either pine or hardwoods may easily be three times as much as from third grade logs.

This is, of course, an argument for holding a woodlot until it is mature instead of cutting it off while the trees are still small. It is also an argument for proper treatment during the life of the forest so that the mature trees will be sound and straight and of the most valuable varieties. A mature stand of hardwoods 80 years old with 50 logs per acre making 5000 board feet is evidently much more profit-

1. "After the Hurricane" Connecticut Woodlands, May 1939.

able to log than a stand 50 years old with perhaps 60 small logs making 1500 board feet, for not only is the yield three times as much but the profit per log is much greater. A pine stand of 80 years may have 100 logs per acre making 10,000 board feet as compared to 120 logs making 3000 board feet at the age of 50 years. As a forest grows older and the trees become more crowded some of the least sturdy will die in an untreated woodland. Under good management these trees are removed in successive cuttings, and an even growth of the remaining trees is maintained.

That Connecticut is capable of producing large and high grade logs was demonstrated in the logs purchased by the Northeastern Timber Salvage Administration from the woodlot of Mr. Arthur H. Griswold in Wethersfield. Fifteen of these oak logs scaled 6,090 board feet or an average of 406 board feet a log. The largest log scaled 630 board feet. Fourteen of these logs were graded No. 1. The net profit to the owner on the fifteen logs is said to have been $115.

These facts are being recognized by an increasing number of the more intelligent lumbermen of the country. Many of them, particularly in the west, have given up the practice of cutting small trees and have found that their operations are increasingly profitable, as they eliminate these trees which were formerly cut at a loss. The practice of selecting the large mature trees and leaving the younger trees for future growth is known as "Selective Logging" or the "Selection System." By it the land is kept perpetually in a productive condition, the soil is protected from injurious exposure to sun and winds and timber of the highest quality and price is raised.

5. THE VALUE OF FORESTS TO THE FUTURE OF CONNECTICUT

INDUSTRIAL VALUE

The State has just established a Development Commission with the purpose of encouraging the establishment of new industries in Connecticut. Undoubtedly the forests, as one of the chief sources of raw materials, must play an important part in such a movement eventually if not immediately.

As already pointed out, Connecticut forests at present are long on small poor grade material and short on large high grade material. Industries might be established in the near future to utilize the small material in making good pulp, material for plastics, charcoal, wood acid or other chemical products. Should such industries be established without some public control of cutting practices they would result in extensive clear cutting just as did the brass, brick and charcoal industries of the past generation. The most profitable form of forest management to the land owner and the one consistent with the greatest benefits to the State as a whole, is one in which the main objective is the raising of high grade lumber, but which produces a large amount of low grade materials through intermediate cuttings while the high grade material is growing.

At the present time Connecticut is producing less than 10 per cent of the approximately 100,000,000 board feet used annually in the state. Under proper management our forests are fully capable of yielding after twenty or thirty years as much lumber as at present consumed, although it is possible that it might still be necessary to import part of the softwood needed by the building trade. This is especially true now that so much of our nearly mature pine and hemlock has been destroyed by the hurricane.

Such a reorientation of forest management would benefit not only the land owners and the manufacturer but indirectly every one who lives in the state. Well managed forests and the industries incident to them employ a great many people. The employment possibilities of a forest depend upon the age and character of the timber. For our Connecticut forests it is fair to estimate forestry operations would be warranted economically at the following rates based upon full time employment of 250 days a year.

Sapling forest	1	man	per	1000	acres
Cordwood "	1	"	"	500	"
Timber "	1	"	"	250	"

Upon this basis our forests can now support at least 3500 men and should in time support from two to four times as many.

As a matter of fact, forest employment is to a considerable extent seasonal. In the older countries comparatively few work the entire year in the woods. The remainder of the year is employed on farms, or on public undertakings like road construction. On such a basis the number of people finding part time employment in the forests would be at least double the figures above. As forest industries are developed the employment in the rural towns would also be considerably increased.

Every one who builds a house pays indirectly a large freight bill on lumber imported into the state. It has been estimated that for the average house this cost alone amounts to at least $300. For the family that rents a house this cost is passed on in the form of monthly payments. Many of the industries of Connecticut use a large amount of lumber either in the process of manufacture or for packing.

Connecticut forests are capable of producing lumber suitable for all these demands. Experience following the hurricane has shown the high quality of our lumber when properly manufactured and graded.

Connecticut grown white pine and white oak had an important part in the building of the state and it was only after the original forests had disappeared that the native second growth timber, now in competition with first growth timber from other parts of the country, fell into disrepute. Builders and contractors are now inclined to criticise our white pine for its low strength, stiffness and nail holding power. While it is true that white pine is not as strong as Doug-

las fir, southern pine or eastern spruce, woods which have largely taken its place in house construction, this handicap can be overcome by using larger sizes of timber and more and larger nails. On the other hand white pine swells and shrinks and warps less than these other lumbers. It is famous for its ease of working which has long made it the popular wood of pattern makers. Its paint holding characteristics are superior to those of the other building lumbers used and this quality alone should endear it to New England, a region which prides itself on keeping well painted.

THE FORESTS AND WILD LIFE

In the early part of this century forests and wild life alike had reached the low point in their history. It was natural that conservationists of all kinds should resort to artificial methods of restocking. In the case of wild life this has meant the establishment of fish hatcheries and the planting of millions of fish of various kinds and the wide distribution of game birds and eggs of several varieties. In the case of the forest it has meant the planting of thousands of acres of abandoned fields with evergreens. None of these measures have been entirely successful and none offer the final solution to the problem. Some varieties of fish have been planted which were not adapted to our streams and many have been planted in streams deficient in the kind of food needed. In the same way experimentation with foreign birds often resulted in failure and even our own grouse and quail found conditions too much changed from the original conditions to which they were adapted to permit successful colonization. The same is true of many forest plantations. Imported trees like Scotch pine have proved a disappointment and even the native white pine has suffered severely from the pine weevil when planted under unnatural conditions.

Conservation of wild life as well as of forests will not be a success until conditions suitable for natural regeneration are obtained. Forest fires have in the past been one of the chief enemies of natural regeneration of both plant and animal life. Widespread clear cutting also creates an artificial condition.

The underlying principle of wild life management is that with the exception of migratory birds our game birds and animals spend their lives within a relatively small area and must have suitable food and shelter throughout the year if they are to thrive and multiply. Numerous small evergreen plantations furnish valuable shelter in winter, but since such plantations are lacking in berry bushes they must not be too extensive and should be broken up by openings and strips of berry bushes or should have a mixture of fruit and nut trees. Old apple trees and wild grape vines should be saved. While large clear cuttings are undesirable, small cuttings and small patches of old fields scattered through a well managed forest are necessary to give best results. Contrary to common opinion frequent thinnings in a hardwood forest tend to preserve good cover because the numerous

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root sprouts from the cut trees persist several years even in dense stands. Good forestry practice does not countenance the cutting of underbrush except on small areas as preparation for forest planting.

The economic returns from wild life except in case of small areas controlled by rich men's clubs are relatively small compared to those possible from forest products. The practice of forestry, therefore, offers the best guarantees that owners will be willing to continue to allow public hunting on their lands.

FORESTS, RECREATION AND SCENIC VALUES

Other forms of recreation besides hunting and fishing are intimately connected with forests. Hiking, picnicking and camping in summer and skiing and snowshoeing in winter are all enjoyed in the woods. In general the larger the trees the greater the enjoyment of people who visit the forests.

Much is said about the beauty of Connecticut, but like the weather little is done about it. Well managed forests with a proper proportion of large trees add much to the beauty of the landscape and have a not inconsiderable financial value in attracting summer residents as well as permanent home seekers. Many places formerly beautiful were temporarily ruined by the loss of shade trees and woods through the hurricane. The health giving qualities of forests have long been recognized.

FORESTS AND WATER SUPPLIES

In any state with the density of population of Connecticut the supply of potable water may well be a limiting factor in the growth of population. Connecticut was naturally rich in clear springs and streams. Some of the former have been destroyed by forest removal and many of the latter have been ruined by pollution. Forests are not only valuable in equalizing run-off, but have great value in preventing erosion and the silting up of streams and in other ways help in preserving a supply of pure water.

A FOREST POLICY

It is evident that if Connecticut is to get the full benefit from its large forest area it must have a more definite forest policy. The following suggestions are believed fundamental to such a policy.

1. There must be adequate protection from fire, insects and disease. Under normal conditions all of these sources of damage are fairly well controlled but any abnormal combination of weather and other unknown factors may result in devastating fires or serious infestations by such insects as the Gipsy Moth.
2. There must be safeguards against excessive taxation. It is believed that present laws afford adequate protection to forest owners as related to owners of other forms of real estate but that the tax burden should be readjusted to lighten the load on all real estate.

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3. The State should own at least three hundred thousand acres of state forests in consolidated tracts of not less than 3000 acres each. These tracts would serve as nucleii for the control of forest fires, for the building of wood using industries and for the spread of forestry knowledge among private owners. They would produce a large amount of high grade lumber for industry. They would furnish labor for unemployed and eventually increase the State's revenue. They would supplement the state parks as recreational areas and would be managed either as game sanctuaries or public hunting grounds according to the needs of the State Board of Fisheries and Game. They would eventually yield a considerable revenue to the State.

4. A system of town forests of smaller area is desirable to serve as local recreational centers, to furnish employment and wood to unemployed residents and eventually increase the revenue of the towns.

5. Some form of public control over forest devastation is necessary. The State regulates the size of fish caught and even prohibits fishing in certain streams. It limits the season for hunting and the bag that the sportsman can take. It limits the speed of automobiles and prohibits unsightly dumps and public nuisances. It controls bathing in certain waters, prohibits stream pollution and excludes people with certain diseases from some industries. Up to the present the owner of a forest may devastate it as though he were alone on an island and his forest had no relation to the welfare of the rest of the state.
 Thirty-five states, including Vermont and New York, have now passed laws authorizing the establishment of Conservation Districts with power to make and enforce laws governing the use of natural resources within their boundaries. This is an approach to the Swedish system of local control and would probably fit Connecticut traditions much better than either Federal or Statewide control.

6. When some system of public control of private forests has been established, a systematic effort should be made to secure new wood using industries especially of the kind that will use such smaller and poorer grades of wood as would result from thinnings.

7. More systematic instruction of forest owners is necessary. Through numerous demonstrations of good practice on the state forests and in private forests, frequent group meetings and the personal contact of foresters, a better understanding of the forestry problems should be brought about. One Extension Forester is not sufficient. Through an adequate force of Forest Rangers working in close cooperation with the Extension Forester much headway could be made in the application of the first principles of forestry which alone would more than double the productivity of our forests.


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